AGU FALL MEETING
San Francisco | 12–16 December 2016

T22C-03: Seismic reflection imaging of the Juan de Fuca plate from ridge to trench: new constraints on the distribution of faulting and evolution of the crust prior to subduction (Invited)

Tuesday, 13 December 2016
10:50 - 11:05
Moscone South - 306

To characterize the evolution of the Juan de Fuca (JdF) plate from ridge to trench, quantify its hydration state prior to subduction, and assess the relationship between along-strike variations in plate structure and Cascadia subduction zone processes, the JdF Ridge-to-Trench Experiment, a joint long streamer multi-channel seismic (MCS) and wide-angle ocean bottom seismometer (OBS) survey was conducted in 2012. This study provides plate-scale images and seismic velocity of the sediments, crust, and shallowest mantle along two ridge-perpendicular transects offshore Oregon and Washington and an ~400 km long trench-parallel line 10-15 km seaward of the Cascadia deformation front (DF). Here we present prestack time migrated MCS images of the three transects. Within the plate interior, we observe numerous small offset faults in the sediment section beginning 50-70 km from the ridge axis with sparse fault plane reflections confined to the upper crust. As the plate bends due to sediment loading and subduction, bright fault plane reflections that extend through the crust and 6-7 km into the mantle are imaged on the Oregon Transect within 40 km from the DF; on the Washington Transect, bending faults are confined to the sediment section and upper-middle crust. The reflection image of the along-strike transect shows more abundant reflectivity south of 45˚50'N coincident with reduced seismic velocity in the lower crust derived from the OBS data (Canales et al., 2016) suggesting more faulted and hydrated crust off Oregon prior to subduction. This regional difference coincides with the plate interface transition from well locked to partially creeping at Cascadia. A series of distinctive, ridgeward-dipping (20°-40˚) lower crustal reflections are imaged in ~6-8 Ma crust along two cross-plate transects and are interpreted as ductile shear zones formed at the JdF ridge in response to temporal variations in mantle upwelling, possibly associated with previously recognized plate reorganizations at 8.5 Ma and 5.9 Ma.

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